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09/898,043	07/05/2001	Nobuhiko Hayashi	010849	2566

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EXAMINER
MONDT, JOHANNES P

ART UNIT	PAPER NUMBER
2826	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/898,043	Applicant(s) HAYASHI	
	Examiner Johannes P Mondt	Art Unit 2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 July 2001* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-24* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-24* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 3 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Information Disclosure Statement

The examiner has considered the items listed in the Information Disclosure Statement filed 07/05/01, which has been entered as Paper No. 3.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. ***Claims 1 – 2*** *are rejected* under 35 U.S.C. 102(b) as being anticipated by Udagawa (5,886,367). Udagawa teaches a nitride based semiconductor light emitting device comprising:

a light-emitting layer composed of a Group III nitride based semiconductor (cf. abstract, sentence 1) and including an active layer (cf. abstract, sentence 1); and

a cladding layer of a first conductivity type (here selected to be p-type) composed of a Group III nitride based semiconductor (cf. column 4, lines 7-9), formed on said light-emitting layer (cf. abstract, sentence 1), having a larger band gap than said active layer (cf. column 3, line 66 – column 4, line 3), and having a lower refractive index than said active

layer (this is so *inherently*, as the refractive index of $Ga_xAl_yIn_{1-x-y(x)}N$ near y=.05 increases as a function of x (see any relevant data series or, for instance, Fig. 3 in "Refractive Index of AlGaInN alloys", T. Peng et al as listed on PTO-892 Form); and

the thickness of said cladding layer of first conductivity type being less than 0.3 μm, namely between 0.02 and 0.5 μm (cf. column 4, lines 14-17).

With regard to claim 2: the Aluminum composition of said cladding layer in the nitride based semiconductor light-emitting device of claim 1 as anticipated by Udagawa is preferably no more than 0.05 (cf. column 4, lines 28-29).

Therefore, Udagawa anticipates claims 1 and 2.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. ***Claims 3, 5 – 10, 12 – 14, 16 – 20, and 23 – 24*** *are rejected* under 35 U.S.C. 103(a) as being unpatentable over Udagawa (5,886,367) in view of Prior Art as admitted by Applicant in the disclosure of his invention. As detailed above, Udagawa anticipates

claim 1 (on which claim 3 depends). Udagawa does not necessarily disclose the further limitation of claim 3. However, the nitride based semiconductor light-emitting device admitted as Prior Art by Applicants (Fig. 8 and page 2, lines 7-11) has a light emitting layer 89 with optical guide layer 90 of first conductivity type (p-type) (cf. page 2, line 10) formed on said active layer for the obvious purpose of providing confinement, said optical guide layer of first conductivity type having a smaller band gap and higher refractive index than said cladding layer (*inherently so,* as said optical guide layer is formed of p-GaN, with band gap equal to 3.4 eV and refractive index at standard blue of 2.41; while the cladding layer for Aluminum content 0.05 (for instance) has a band gap of 3.51 eV and refractive index at standard blue well approximated by linear extrapolation (dashed and solid curves being close in Fig. 3 of Peng et al, loc. cit., and hence considerably lower than that of GaN as the index of refraction of AlN is lower than that of GaN (see Table 1 of Peng et al, loc. cit.)) while said optical guide layer has a larger band gap and lower refractive index (at standard blue) than said active layer (*inherently so*, because for the same reasons quoted above, the energy band gap of GaN being larger than that of $Al_xGa_yIn_{1-x-y}N$ (cf. column 3, lines 62-65) for some values in the range of the invention taught by Udagawa, considering that the band gap of InN is considerably lower than that of GaN, having the largest lattice constant (Table 1 of Peng et al) while, on the other hand, the refractive index of InN is very high, cf. Fig. 1)); said cladding layer of the first conductivity type being formed on said optical guide layer of first conductivity type.

Therefore, it would have been obvious to one of ordinary skills in the art to modify the invention by Udagawa so as to include the further limitation of claim 3.

With regard to claim 5: Prior Art as admitted by Applicants features a ridge portion of the upper cladding layer (first conductivity type or p-type) (cf. Fig. 8) for enhanced luminous efficiency. Therefore, the further limitation of claim 5 does not distinguish over the Prior Art.

With regard to claim 6: Udagawa teaches the said Group III nitride based semiconductor to contain gallium, as well as aluminum and indium (cf. abstract, sentence 1). Therefore, the further limitation defined by claim 6 does not distinguish over the cited prior art.

With regard to claim 7: Udagawa teaches the cladding layer of first conductivity type to contain aluminum and gallium (cf. column 4, lines 7-9). Therefore, the further limitation defined by claim 7 does not distinguish over the cited prior art.

With regard to claim 8: Udagawa teaches the active layer to contain both gallium and indium (cf. abstract, sentence 1). Therefore, the further limitation defined by claim 8 does not distinguish over the cited prior art.

With regard to claim 9: although Udagawa does not necessarily teach the further limitation as defined by claim 9, the use of Multiple Quantum Wells (inherently including one or more well layers with quantum barrier layers) is standard in the art of semiconductor light-emitting devices, as witnessed for instance by the Prior Art as admitted by Applicant in the disclosure, teaching a Multiple Quantum Well 89 (cf. Fig. 8 and page 2, lines 8-9). Multiple Quantum Wells offer the advantage of increased gain

coupling coefficient, which is an immediate advantage also for the invention by Udagawa. Therefore, it would have been obvious to one of ordinary skills in the art to modify the invention by Udagawa so as to include the further limitation as it has been defined by claim 9.

With regard to claim 10: it is inherent to a laser cavity and its immediate surrounding layers that the laser field amplitude is oscillatory within said cavity (here the MQW) and exponential outside of it, in the surrounding layers. Therefore, the further limitation as defined by claim 10 does not distinguish over the prior art.

With regard to claim 12: the first conductivity type in Udagawa is p-type, as already mentioned. Therefore, the further limitation as defined by claim 12 does not distinguish over the prior art.

With regard to claim 13: Udagawa teaches a (lower) cladding layer 103 of conductivity type opposite to said upper cladding layer 105 (cf. column 3, lines 60-62 and column 4, lines 12-14), hence of second conductivity type, and composed of a Group III nitride based semiconductor (cf. column 4, lines 7-9) with said light-emitting or active layer 104 (cf. column 3, line 62) being formed on said lower cladding layer 103 of second conductivity type. Therefore, the further limitation as defined by claim 13 does not distinguish over the prior art.

With regard to claim 14: Udagawa teaches a nitride based semiconductor light emitting device comprising a light emitting layer composed of a Group III nitride based semiconductor (cf. column 3, lines 62-65) and including an active layer (cf. column 3, lines 62-65). Udagawa does not necessarily disclose the further limitation as defined by

claim 14 that said nitride based semiconductor light emitting device also includes an optical guide layer with properties and relation to an electrode as delineated in claim 14. However, the physical constitutions of the optical guide layer 90 and of the contact layer 92 (in electrical contact with p-side electrode 131) in the Prior Art as admitted by Applicants are identically the same: p-GaN (cf. page 2, lines 10-13). Therefore, their implied functional potentials are the same, while it is an obvious advantage to use a contact layer that also performs the role of an additional optical guide layer, which advantage naturally applies equally to the invention taught by Udagawa as confinement is a general advantage in the art of light-emitting semiconductor devices. Furthermore, layer 92 is formed on the active layer 89, while by virtue of its constitution it has a larger band gap and lower refractive index than the active layer (please be referred to the discussion of claim 3 as detailed above).

Therefore, it would have been obvious to one of ordinary skills in the art to modify the invention by Udagawa at the time it was made so as to include an optical guide layer of first conductivity type formed on the active layer, an electrode, which is brought into contact with said optical guide layer of first conductivity type, the optical guide layer of first conductivity type having a larger band gap and lower refractive index than the active layer, i.e., to include all limitations defined by claim 14.

With regard to claim 16: Prior Art as admitted by Applicants show the optical guide layer 92 of first conductivity type (p-GaN) to have a ridged portion and said electrode 131 is brought in ohmic contact with an upper face of 92. Therefore, the further limitation defined by claim 16 does not distinguish over the prior art.

With regard to claim 17: the Group III nitride based semiconductor of Udagawa contains gallium, aluminum, and indium (cf. column 3, lines 62-65).

With regard to claim 18: Udagawa teaches the active layer to contain gallium and indium (cf. column 3, lines 62-65), while the optical guide layer 90 taught by Prior Art as admitted by Applicant contains gallium (cf. page 2, lines 10-11), which is an obvious material choice, considering the occurrence of GaN based layers in the device, and said selection is equally obvious for Udagawa's device for the same reason. Therefore, it would have been obvious to one of ordinary skills in the art to modify the invention as defined by claim 14 at the time it was made so as to include the further limitation of claim 18.

With regard to claim 19: although Udagawa does not necessarily teach the further limitation as defined by claim 19, the use of Multiple Quantum Wells (inherently including one or more well layers with quantum barrier layers) is standard in the art of semiconductor light-emitting devices, as witnessed for instance by the Prior Art as admitted by Applicant in the disclosure, teaching a Multiple Quantum Well 89 (cf. Fig. 8 and page 2, lines 8-9). Multiple Quantum Wells offer the advantage of increased gain coupling coefficient, which is an immediate advantage also for the invention by Udagawa. Therefore, it would have been obvious to one of ordinary skills in the art to modify the invention by Udagawa so as to include the further limitation as it has been defined by claim 19.

With regard to claim 20: it is inherent to a laser cavity and its immediate surrounding layers that the laser field amplitude is oscillatory within said cavity (here the

MQW) and exponential outside of it, in the surrounding layers. Therefore, the further limitation as defined by claim 20 does not distinguish over the prior art.

With regard to claim 23: the first conduction type in the context of the cited prior art is p-type. Therefore, the further limitation of claim 23 does not distinguish over the prior art as cited.

With regard to claim 24: Udagawa teaches a (lower) cladding layer 103 of conductivity type opposite to said upper cladding layer 105 (cf. column 3, lines 60-62 and column 4, lines 12-14), hence of second conductivity type, and composed of a Group III nitride based semiconductor (cf. column 4, lines 7-9) with said light-emitting or active layer 104 (cf. column 3, line 62) being formed on said lower cladding layer 103 of second conductivity type. Therefore, the further limitation as defined by claim 24 does not distinguish over the prior art.

5. ***Claims 4, 15, and 21*** *are rejected* under 35 U.S.C. 103(a) as being unpatentable over Udagawa and Prior Art as admitted by Applicant as applied to claim 3 above, and further in view of Steigerwald (JOM, volume 49, issue 9, pp. 18-23 (1997)).

Neither Udagawa nor Prior Art as admitted by Applicant necessarily teaches the further limitation as defined by claim 4. However, the application of a carrier leakage preventing layer of first conductivity type formed on said active layer and having a larger band gap than said optical guide layer of first conductivity type is standard in the industry, as witnessed by Steigerwald et al, who show (cf. Fig. 5) the Nichia Company's Blue Light-Emitting device with a layer formed of p-type $Al_{0.2}Ga_{0.8}N$ interposed between

a multiple quantum well and the p-GaN optical guide layer. Therefore, it would have been obvious to one of ordinary skills in the art to modify the invention as defined by claim 3 so as to include the further limitation as defined by claim 4.

With regard to claim 15: Neither Udagawa nor Prior Art as admitted by Applicant necessarily teaches the further limitation as defined by claim 4. However, the application of a carrier leakage preventing layer of first conductivity type formed on said active layer and having a larger band gap than said optical guide layer of first conductivity type is standard in the industry, as witnessed by Steigerwald et al, who show (cf. Fig. 5) the Nichia Company's Blue Light-Emitting device with a layer formed of p-type $Al_{0.2}Ga_{0.8}N$ interposed between a multiple quantum well and the p-GaN optical guide layer. Therefore, it would have been obvious to one of ordinary skills in the art to modify the invention as defined by claim 15 so as to include the further limitation as defined by claim 15.

With regard to claim 21: the active layer in Udagawa, as well as in Prior Art as admitted by Applicants, as well as in Steigerwald, contains gallium and indium; said optical layer as taught in the Prior Art (and Steigerwald, see Fig. 5) as admitted by Applicants contains gallium; and said carrier leakage preventing layer of first conductivity type as shown in Steigerwald (Fig. 5) contains gallium and aluminum. Therefore, the further limitations as defined by claim 21 do not distinguish over the cited prior art.

6. ***Claim 11*** *is rejected* under 35 U.S.C. 103(a) as being unpatentable over Udagawa (5,886,367) in view of Hashimoto et al (6,096,394). Udagawa does not necessarily teach the further limitation of claim 11. However, the use of current-blocking layers formed on or in the upper cladding layer (i.e., said cladding layer of first conductivity type, p-type here) with a striped opening *for the purpose* of limiting the current flow to the active layer is standard in the art of Group III light emitting diodes as witnessed for instance by Hashimoto et al (cf. Fig. 12) who teach a current-blocking layer 46 with stripe-shaped window 46a buried in the upper cladding layer 47 (cf. column 17, lines 31-34). Said purpose is equally valid for the present invention, generic as it is to all light-emitting diodes to enhance efficiency. Therefore, it would have been obvious to one of ordinary skills in the art to modify the invention by Udagawa at the time it was made so as to include the further limitation of claim 11.

7. ***Claim 22*** *is rejected* under 35 U.S.C. 103(a) as being unpatentable over Udagawa and Prior Art as admitted by Applicants in the disclosure as applied to claim 14 above, and further in view of Hashimoto et al (6,069,394). As detailed above, claim 14 is unpatentable over Udagawa in view of Prior Art as admitted by Applicants. Neither Udagawa nor Prior Art as admitted by Applicants disclose the further limitation of claim 22. However, the use of current-blocking layers formed on or in the upper cladding layer (i.e., said cladding layer of first conductivity type, p-type here) with a striped opening *for the purpose* of limiting the current flow to the active layer is standard in the art of Group III light emitting diodes as witnessed for instance by Hashimoto et al (cf. Fig. 12) who

teach a current-blocking layer 46 with stripe-shaped window 46a buried in the upper cladding layer 47 (cf. column 17, lines 31-34). Said purpose is equally valid for the present invention, generic as it is to all light-emitting diodes to enhance efficiency. Therefore, it would have been obvious to one of ordinary skills in the art to modify the invention by Udagawa at the time it was made so as to include the further limitation of claim 22.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Johannes P Mondt whose telephone number is 703-306-0531. The examiner can normally be reached on 8:00 - 18:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan J Flynn can be reached on 703-308-6601. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7724 for After-Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

JPM
February 24, 2002